PARKS

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

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CRUISE RESULTS

NOAA Vessel Miller Freeman, R-223 - Cruise 88-09
1988 Alaska Fisheries Science Center
and Southwest Fisheries Science Center Cooperative West Coast
Upper Continental Slope Groundfish Survey
November 25-December 16, 1988

A cooperative survey of the groundfish resource off the west coast between Heceta Head and Cape Lookout, Oregon (44°09'-45°21'N Lat.) was completed by Alaska Fisheries Science Center (AFSC) and Southwest Fisheries Science Center (SWFC) scientists aboard the NOAA research vessel Miller Freeman during the period November 25-December 16, 1988. The depth boundaries of this survey were 183-1,280 m (Fig. 1). This report summarizes the preliminary results of the survey.

OBJECTIVES

The objectives of the 1988 cooperative groundfish survey were:

1. To examine sablefish (Anoplopoma fimbria) size, sex ratio, age, and reproductive condition as a function of bathymetric distribution in the late winter.

2. To conduct a limited area pilot study to compare area-swept (bottom trawl) and egg production estimates of sablefish abundance and spawning biomass.

3. To obtain extensive biological data including sex, length, weight, and maturity for Dover sole (Microstomus pacificus), shortspine thornyhead (Sebastolobus alascanus), arrowtooth flounder (Atheresthes stomias), and designated key rockfish (Sebastes spp.) species.

4. To determine size and age at first maturity, food habits, and habitat characteristics of key shelf species including sablefish, Dover sole, shortspine thornyhead, arrowtooth flounder, and rockfishes.

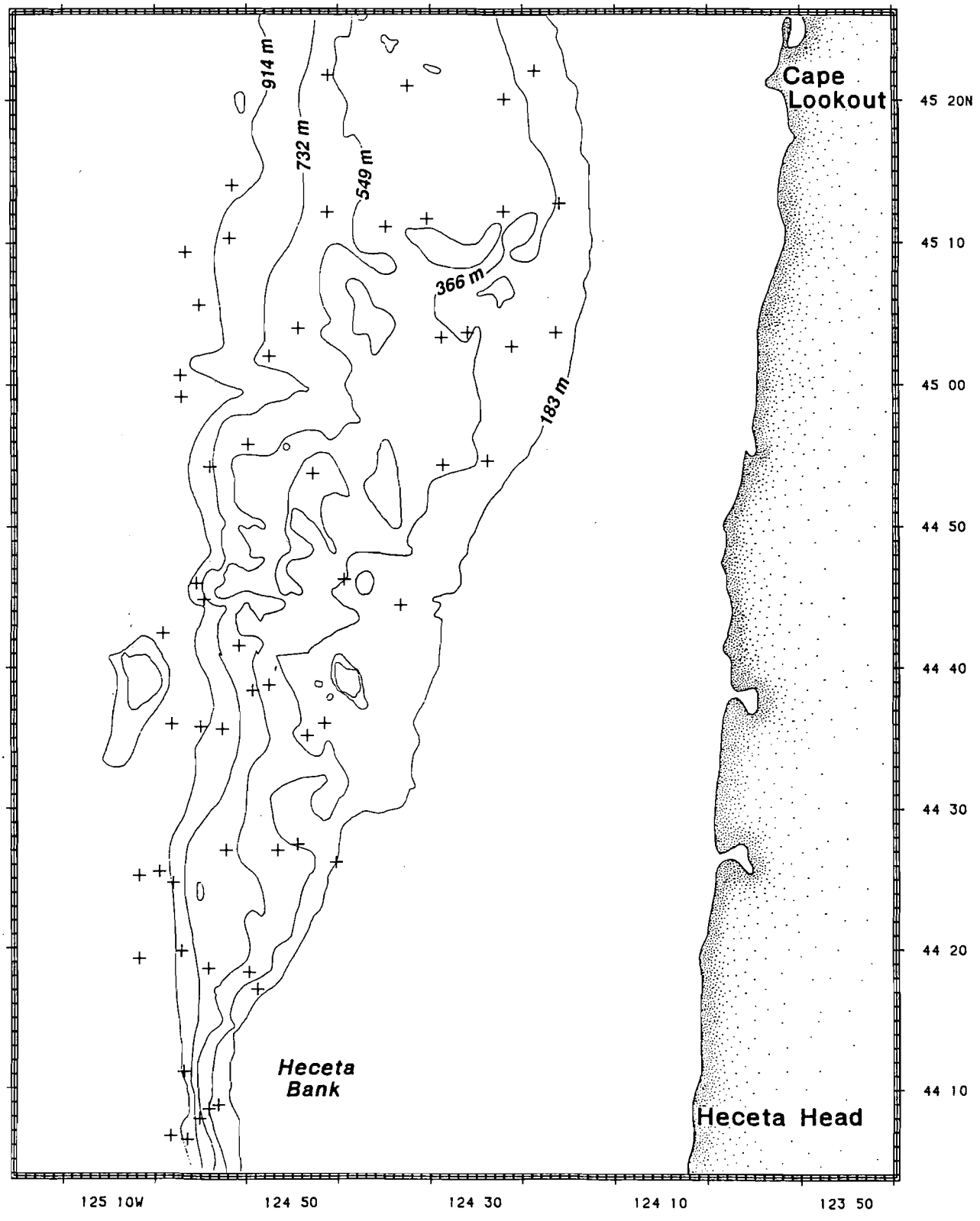

Figure 1.--Survey area showing the 57 successful tows of the 1988 Alaska Fisheries Science Center and Southwest Fisheries Center Cooperative Survey, 25 November - 16 December, 1988. Equivalent depth intervals are 183 m = 100 fm, 366 m = 200 fm, 549 m = 300 fm, 732 m = 400 fm, 914 m = 500 fm, 1097 m = 600 fm, 1280 m = 700 fm.

5. To describe the physical characteristics (temperature, oxygen content, salinity, current speed and direction) of sablefish habitat and relate them to sablefish size, reproduction, and distribution.

6. To continue studies of juvenile sablefish movements through tagging.

7. To describe the fish community of the continental slope at a variety of depths.

8. To obtain measurements of fishing dimensions of the polyethylene Noreastern bottom trawl using SCANMAR mensuration equipment to better understand the relationship between trawl warp scope and the depth to which the trawl sinks when towed at 2-3 knots.

9. To obtain stomach samples from six species of bathypelagic fish which inhabit deep slope waters to study their ecological relationships.

10. To collect tissue samples, age structures, and ripe ovaries by size and sex category from Pacific whiting (Merluccius productus) for studies of fecundity and parasitism.

11. To obtain histological, pathological, and parasitological samples from arrowtooth flounder, Dover sole, sablefish, Tanner crab (Chionoecetes tanneri), and deep-sea king crab (Lithodes couesi).

VESSEL AND GEAR

The research vessel Miller Freeman is a 65.5 m (215 ft) stern trawler equipped with modern trawling, oceanographic and hydrographic sampling systems and electronics. The standard survey trawl used was the polyethylene high-opening Noreastern bottom trawl equipped with mud-sweep roller gear constructed of 20.3 cm (8 in) rubber discs strung on 1.6 cm (5/8 in) chains. Dimensions of this net are: 27.2 m (89 ft) headrope; 37.4 m (123 ft) footrope with "flying wings"; body constructed of polyethylene mesh; 8.9 cm (3½ in) stretched mesh nylon codend; and a 3.2 cm (1¼ in) stretched mesh codend liner. Each wing was attached to a 907 kg (2000 lb), 1.8 x 2.7 m (6 ft x 9 ft) steel V-door by three 55 m (180 ft) dandylines made of 1.6 cm (5/8 in) galvanized steel cable. A SCANMAR trawl mensuration system was used to obtain mean fishing dimensions of the Noreastern trawl.

Additional sampling equipment used during the survey included standard CalCOFI MANTA neuston nets, CalCOFI (CalBOBL) shallow and deep (DCalBOBL) bongo plankton nets, expendable

bathythermograph (XBT), and Plessey salinity-temperature-depth-dissolved oxygen (CTDO) sensors.

SURVEY DESIGN AND METHODS

The area surveyed included a portion of the International North Pacific Fisheries Commission (INPFC) Columbia statistical area from Heceta Head, Oregon (44°09'N) to near Cape Lookout, Oregon (45°21'N lat) between the depths of 183 and 1,280 m (100 and 700 fm) (Fig. 1). The survey area was stratified into six depth intervals: 183-366, 367-549, 550-732, 733-914, 915-1,097, 1,098-1,280 m (100-200, 201-300, 301-400, 401-500, 501-600, 601-700 fm). Trawl stations were placed randomly along tracklines situated 16.7 km (9 nmi) apart which were drawn roughly perpendicular to slope isobaths. Stations were allocated proportionally to the trackline length across each depth interval as follows:

Linear distance along trackline within depth stratum	Number of stations allocated to trackline section
≤7.0 nmi (13.0 km)	1
7.1-14.0 nmi (13.1-25.9 km)	2
14.1 nmi (26.1 km)	3

At least one trawl station was assigned to each depth stratum along each trackline.

At depths shallower than 732 m (400 fm) the trawl was towed for 30 minutes using a scope ratio of approximately 2.5:1. Sixty-minute hauls were made at deeper stations using scope ratios of approximately 2:1. Towing speed was approximately 2 knots at all stations. Ichthyoplankton and hydrographic sampling was conducted at 50% of the bottom trawl stations and CTDs were taken at all stations. SCANMAR trawl mensuration gear was utilized on all stations shallower than 550 m (300 fm). Stations were surveyed with the ship's fathometer and Loran plotter before and during net deployment. All catches were sorted to the lowest possible taxon, weighed, counted, and processed according to standard AFSC and SWFC protocol. Station data including time, position, trawl specifications, distance fished, and catch and length information, were stored for later analysis using shipboard computer systems. Age samples by sex-centimeter category and other biological data were collected from the major fish species encountered. Ichthyoplankton and special study collections were stored in appropriate fixatives or frozen.

RESULTS

The trawling operations were successful at 57 of the 62 (93%) sampling stations. Some stations were moved from the original sites to find suitable terrain for trawling. The five unsuccessful tows resulted in extensive damage to the net. Eight additional tows were completed using a Noreastern net equipped with standard AFSC roller gear (35.6 cm bobbins) for comparative purposes.

The 20 most abundant species taken by depth stratum were ranked in order of catch per unit effort (CPUE) expressed in kg/km trawled (Table 1). The mean CPUE distributions by depth stratum for Tanner crab and five groundfish species are presented in Figure 2. Relative abundance over all depth strata and presence or absence in a given depth stratum by species can be seen in Figure 2.

Sablefish were taken in each depth stratum and was the most abundant species (179.3 kg/km) in the 550-732 m stratum and was the second or third most abundant species in four of the other five depth strata. Dover sole were taken in all strata and was the most abundant species (95.9 kg/km) in the 367-549 m stratum. Dover sole was also the third most abundant species in two of six depth strata. Longspine thornyhead were taken in all strata except the 183-366 m stratum and was the most abundant species (117.3 and 85.0 kg/km) in the 733-914 and 915-1,097 m strata. Longspine thornyhead was also the second most abundant species in one of the other four depth strata. Shortspine thornyhead were taken in all strata and were most abundant (38.2 kg/km) in the 550-732 m stratum. Shortspine thornyhead was also the third most abundant species in the three shallowest depth strata. Giant grenadier were taken only in the four deepest strata and was the most abundant species (41.7 kg/km) in the 1,098-1,280 m stratum. Tanner crab were taken only in the four deepest strata and were most abundant (39.9 kg/km) in the 550-732 m stratum.

Individual length, weight, maturity stage, otoliths, and ovaries were collected from target species (sablefish, Dover sole, shortspine thornyhead, and arrowtooth flounder). These and other major species were sampled for feeding habits, reproductive condition, otoliths, and individual weights. Length measurements were taken from subsamples of all fish species in each catch. The length frequency distributions for sablefish, Dover sole, shortspine thornyhead, and arrowtooth flounder over all depth strata are presented in Figure 3. Table 2 summarizes the biological data collected during the survey.

Table 1.--Mean CPUE (kg/km) of the 20 most abundant groundfish and selected crab species caught during the 1988 Cooperative Slope Survey coordinated between NWAFC and SWFC.

Species Name	Stratum 1 183-366 m	Species Name	Stratum 2 367-549 m	Species Name	Stratum 3 550-732 m	Species Name	Stratum 4 733-914 m
Spiny dogfish	527.1	Dover sole	95.9	Sablefish	179.3	Longspine thornyhead	117.3
Splitnose rockfish	29.6	Sablefish	28.4	Tanner crab	39.9	Sablefish	54.0
Shortspine thornyhead	25.2	Shortspine thornyhead	27.1	Shortspine thornyhead	38.2	Dover sole	24.9
Longnose skate	19.0	Pacific ocean perch	18.0	Dover sole	36.1	Shortspine thornyhead	16.2
Pacific hake	17.8	Longnose skate	12.8	Longspine thornyhead	34.8	Tanner crab	6.6
Dover sole	15.3	Pacific hake	11.0	Giant grenadier	8.5	Giant grenadier	6.4
Rex sole	11.2	Arrowtooth flounder	10.8	Longnose skate	3.8	California slickhead	3.3
Slender sole	11.1	Rex sole	6.4	Flapjack devilfish	2.9	Deepsea sole	2.1
Spotted ratfish	10.2	Darkblotched rockfish	3.4	Black skate	2.0	Pacific grenadier	1.5
Sablefish	9.4	Bigfin eelpout	3.3	Twoline eelpout	1.3	Threadfin slickhead	1.1
English sole	9.0	Bering skate	2.8	Brown cat shark	1.2	Bathybembix bairdii	1.0
Bering skate	8.1	Slender sole	2.8	Pacific hake	1.1	Flapjack devilfish	0.9
Petrale sole	7.0	Longspine thornyhead	2.2	Pacific grenadier	0.9	Pacific hagfish	0.7
Arrowtooth flounder	5.7	Brown cat shark	2.1	Blacktail snailfish	0.8	Chionoecetes sp.	0.6
Sharpchin rockfish	4.7	Spiny dogfish	1.9	Black eelpout	0.8	Twoline eelpout	0.5
Darkblotched rockfish	3.9	Pacific halibut	1.8	Rex sole	0.7	Black skate	0.5
Pacific ocean perch	2.8	Blacktail snailfish	1.4	Pacific flatnose	0.6	Brown cat shark	0.4
Chinook salmon	2.5	Rougheye rockfish	1.4	Bering skate	0.4	Snakehead eelpout	0.2
Greenstriped rockfish	2.5	Aurora rockfish	1.0	California slickhead	0.4	Spiny dogfish	0.2
Bigfin eelpout	2.4	Pacific hagfish	0.9	Deepsea sole	0.4	Pacific hake	0.2
Number of hauls	12	Number of hauls	14	Number of hauls	9	Number of hauls	8

Species Name	Stratum 5 915-1097 m	Species Name	Stratum 6 1098-1280 m	Species Name	All Strata 183-1280 m
Longspine thornyhead	85.0	Giant grenadier	41.7	Spiny dogfish	88.2
Sablefish	31.6	Longspine thornyhead	37.4	Sablefish	53.8
Dover sole	19.7	Sablefish	19.8	Longspine thornyhead	46.1
Giant grenadier	18.4	Pacific grenadier	18.7	Dover sole	32.3
Shortspine thornyhead	16.0	Tanner crab	9.3	Shortspine thornyhead	21.9
Pacific grenadier	7.2	Shortspine thornyhead	8.5	Giant grenadier	12.5
California slickhead	4.0	Pacific flatnose	7.6	Tanner crab	9.8
Tanner crab	3.0	Black skate	5.2	Longnose skate	6.0
Deepsea sole	2.6	Dover sole	3.0	Pacific hake	5.0
Twoline eelpout	2.0	Deepsea sole	2.5	Splitnose rockfish	5.0
Black skate	1.7	Chionoecetes sp.	2.2	Pacific grenadier	4.7
Chionoecetes sp.	0.9	California slickhead	1.3	Pacific ocean perch	3.5
Bathybembix bairdii	0.6	Twoline eelpout	0.9	Rex sole	3.0
Pacific hagfish	0.6	King-of-the-salmon	0.4	Arrowtooth flounder	2.8
Pacific flatnose	0.3	Pacific hagfish	0.4	Slender sole	2.3
Snakehead eelpout	0.3	Paralomis multispina	0.4	Bering skate	1.9
Brown cat shark	0.3	Lithodes couesi	0.3	Spotted ratfish	1.8
Flapjack devilfish	0.2	Robust blacksmelt	0.2	Black skate	1.6
Threadfin slickhead	0.2	Deepsea skate	0.2	California slickhead	1.5
Robust blacksmelt	0.2	Pacific hake	0.2	English sole	1.5
Number of hauls	6	Number of hauls	8	Number of hauls	57

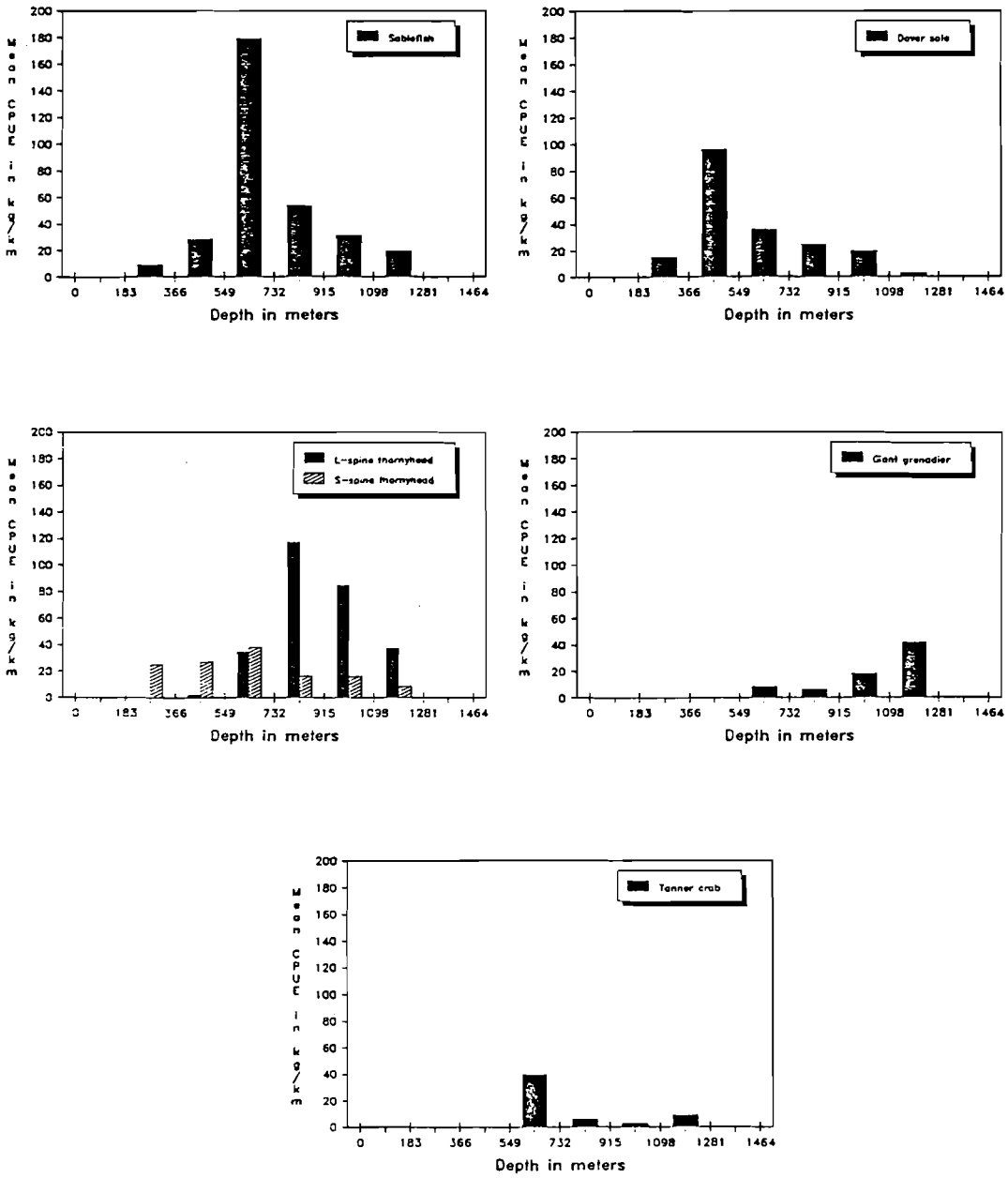

Figure 2.--Summary of the CPUE distributions, by depth stratum for five fish species and Tanner crab during the 1988 cooperative groundfish survey. Longspine thornyhead and shortspine thornyhead appear together on one graph.

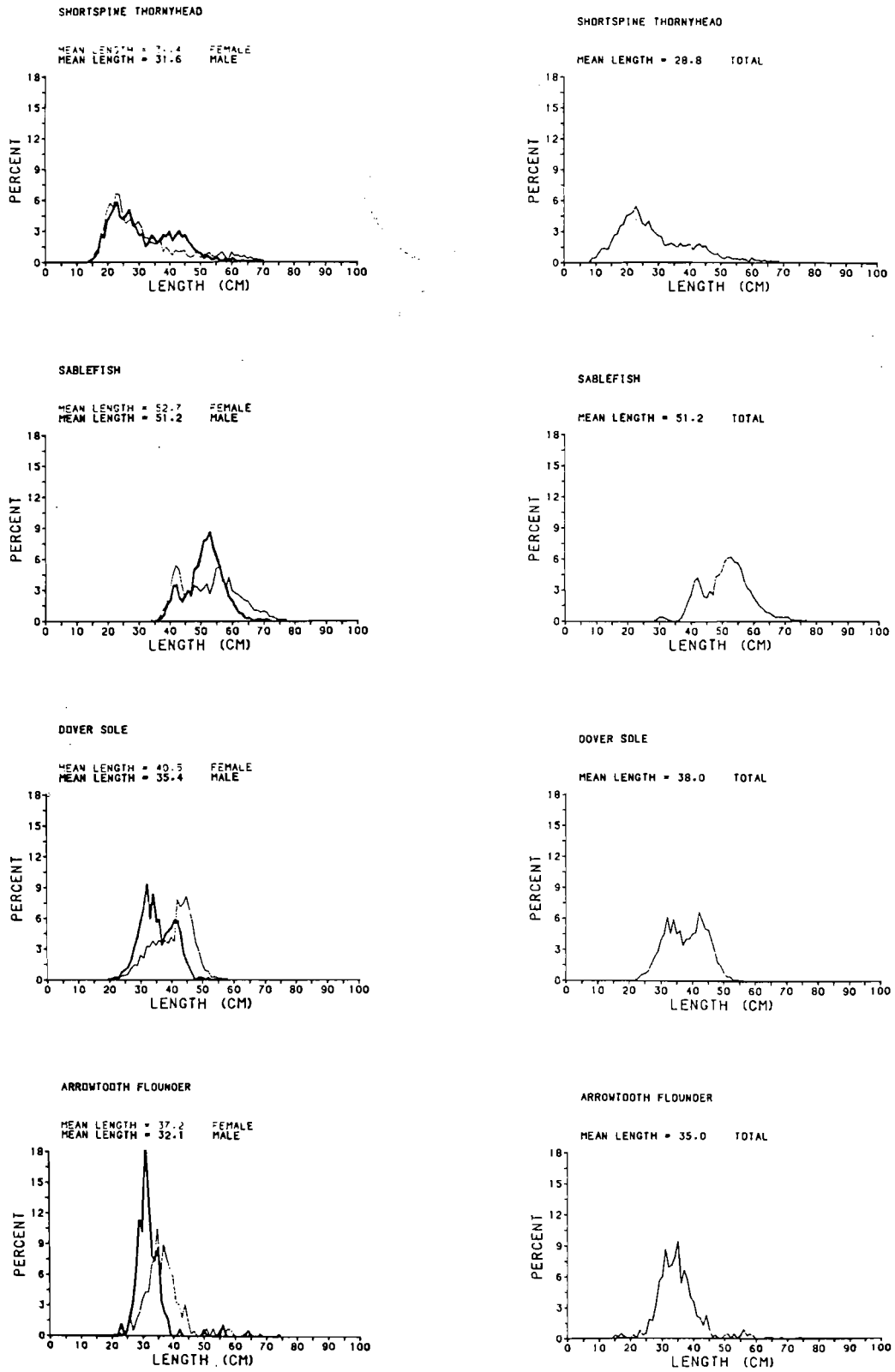

Figure 3.--Size composition (fork length) of primary target species pooled over all depth strata (183-1280 m or 100-700 fm). The dark curve on the Male/Female plots represents the male population and the lighter curve represents the female population.

Table 2.--Summary of biological data collected during the survey. Abbreviations used include: length frequencies (LF), stomach and contents (Sto), otoliths for age determination (Oto), individual fish weight (Wgt), fecundity samples of whole ovaries (Fec), individual fish maturity observations (Mat), and fish maturity determination plus collection of a piece of the ovary to verify classifications (Mat/P).

	LF	Sto	Oto/Wgt	Fec	Mat/P	Mat
Sablefish	3,303	359	751	330	850	850
Dover sole	3,067	517	548	390	850	850
Shortspine thornyhead	4,442	353	883	210	900	900
Arrowtooth flounder	648	---	389	389	---	389
Darkblotched rockfish	252	---	157	140	---	157
Pacific whiting	967	---	221	86	---	221
Deep-sea sole	531	151	---	---	---	---
Longspine thornyhead	4,558	375	---	---	---	---
Flatfish	8,816	---	---	---	---	---
Roundfish	23,478	---	---	---	---	---
All species combined	34,797	---	---	---	---	---

Tissue samples were collected from fish and invertebrate species to check for viral organisms and parasitic infections (myxozoans). Hematology samples were taken from sablefish and Pacific whiting. Histological workups were also performed on all target species. Samples collected for the Pathology Task of the AFSC included Dover sole, arrowtooth flounder, Pacific whiting, shortspine thornyhead, sablefish, and selected crabs.

Eggs, larvae, and oceanographic samples were collected as follows:

ACTIVITY	ATTEMPTED	SUCCESSFUL
Bottom trawls	70	65
MANTA neuston samples	27	27
Standard CalCOFI (CalBOBL) oblique plankton samples	27	27
Deep CalCOFI (DCalBOBL) oblique plankton samples	20	20
CTDOs	65	65
Surface temperatures	70	70
Salinity samples	64	0[1]
Oxygen titrations	144	144

[1] Salinity samples were collected but not analyzed due to malfunction of auto-salinometer.

Reversing thermometer observations were made to calibrate the Seabird CTDO system.

A SCANMAR net mensuration system was used to measure the fishing dimensions of the Noreastern trawl with "mudsweep" roller gear at 26 trawl stations and a Noreastern trawl with standard AFSC roller gear at 8 stations. Wing spread of the Noreastern trawl

with "mudsweep" gear ranged from 12.7 to 17.5 m and averaged 14.7 m. Wing spread for the Noreastern trawl with standard AFSC roller gear ranged from 14.6 to 17.2 m and averaged 16.2 m.

Eighty-nine juvenile (<40 cm) sablefish were tagged and released during the survey.

DISPOSITION OF DATA

Reproductive data and accompanying biological specimens, Dover sole and sablefish otoliths--Dr. John Hunter, SWFC, La Jolla.

Other biological data, original data forms, computer logged data, and frozen specimens--Tom Dark and Paul Raymore, AFSC, Seattle and AFSC computer database.

Data and samples from CalBOBL, DCalBOBL, MANTA, and CTDO--William Flerx, SWFC, La Jolla.

Pathology and histology specimens--Dr. Al Sparks and Linda Cherepow, AFSC, Seattle.

SCANMAR mensuration data--Craig Rose and David Roetcisoender, AFSC, Seattle.

PERSONNEL

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